

Blood Glucose Concentration and Ischemic Heart Failure

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SUMMARY:

BACKGROUND:

Schematic heart failure (IHF) is the most common cause of congestive heart failure. Several studies have revealed that hyperglycemia is an independent risk factor for the progression of IHF in the general population.

OBJECTIVE:

Is to evaluate the relationship between fasting blood glucose concentration and the development of IHF in patients with CAD.

METHODS:

This study included 28 patients with IHF, 22 patients with coronary artery disease (CAD) without HF and 22 healthy controls. Fasting plasma glucose, total cholesterol, and low density lipoprotein-cholesterol (LDL-C) were measured in these two groups of patients and controls.

RESULTS:

The present study revealed that the mean (\pm SEM) value of fasting plasma glucose in patients with IHF (127 ± 7.64 mg/dl) was significantly higher than that obtained from CAD patients without HF (93.6 ± 3.96 mg/dl, $P < 0.0001$) as well as from healthy controls (80.8 ± 2.52 mg/dl, $P < 0.0001$). The mean values (\pm SEM) of serum total cholesterol and LDL-Cholesterol did not differ significantly among the three groups of the present study.

CONCLUSION:

This study showed that serum glucose level may play an important role (partially) in the development and progression of IHF in patients with CAD and normal cardiac contractile function.

KEYWORDS: ischemic heart failure, coronary artery disease, plasma glucose level.

INTRODUCTION:

Heart Failure (HF) is a complex clinical syndrome that can result from any structural or functional cardiac disorder that impairs the ability of the ventricle to fill with or eject blood. The cardinal manifestations of HF are dyspnea and fatigue⁽¹⁾. HF affects approximately 10% of those over 80 years old⁽²⁾. It is the leading cause of death in industrialized countries⁽³⁾ and the single most common reason for medical admission to hospitals⁽⁴⁾.

Ischemic heart failure (IHF) is the most common cause of congestive heart failure (CHF)^(5, 6). Coronary artery disease (CAD) is the cause of HF in about two-thirds of patients with left ventricular (LV) systolic dysfunction⁽¹⁾. Postmortem studies demonstrated extensive atherosclerosis with total occlusion of at least one of the three major epicardial arteries, LV dilatation, and an increase in LV mass^(5,6).

Several epidemiological reports have shown that diabetes mellitus (DM) is a direct independent risk factor for the development of HF in the general population^(7, 8, 9). Hoogwerf et al, 2002⁽¹⁰⁾ observed that the relation between blood glucose and coronary heart disease (CHD) risk is continuous and regarded across the range of non-diabetic glucose values (fasting glucose level < 125 mg/dl) independent of traditional (smoking, obesity and dyslipidemia) and non-traditional (homocysteinuria, lipoprotein (a)) risk factors.

The aim of this study is to determine the relation between fasting plasma glucose levels and the prevalence of IHF in patients attending a coronary angiography unit – Ibn-Al-Bitar Hospital, Baghdad.

SUBJECTS AND METHOD:

This study was conducted at Ibn Al-Bitar Hospital-Baghdad, during the period between Jun.-2005 and Dec.-2005. Fifty patients and 22 healthy control subjects were included in this study. The patients are classified into two groups:

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Group I (IHF Group): it comprised 28 patients aged 44-72 years (6 females and 22 males) with ischemic heart failure (IHF).

Group II (CAD without HF Group): it consisted of 22 patients aged 41-77 years (3 females and 19 males) with coronary artery disease (CAD) who have had normal cardiac contractile function (normal LV function).

Diagnosis criteria of CAD and IHF depended on the basis of cardiac catheterization and left ventriculopathy. Patients with proved CAD angiographically and who have had preserved LV function (LVEF > 50%) were included in group II, while those with IHF who had CAD angiographically in the presence of LVEF of less than 50% were grouped in group I. In each patient of these two groups detailed history and physical examination were performed. ECG was reviewed by a senior cardiologist for changes suggesting recent or old myocardial infarction and for changes suggestive of ischemia.

CONTROLS:

This group involved 22 healthy persons aged 28-62 years (8 females and 14 males).

Five milliliters (mls) of an overnight fasting (at least 10-12 hours) blood sample was aspirated from peripheral vein of each patient and control subject. The aspirated blood was transferred to plain test tube, left to clot and then centrifuged for 10 minutes at 3000 r.p.m. The clear separated serum was stored at -20°C until used for measurement of the concentrations of glucose, total cholesterol and low-density lipoprotein- (LDL) cholesterol. Fasting plasma glucose was evaluated according to the enzymatic colorimetric method of Trinder, 1969⁽¹¹⁾. Serum total cholesterol was estimated according to

the enzymatic colorimetric method of Allain et al, 1974⁽¹²⁾. The LDL-Cholesterol was calculated by using the formula of Friedwald et al, 1972 (13).

RESULTS:

This study included 28 patients with IHF, 22 patients with CAD without HF and 22 healthy controls.

Table 1 shows the clinical characteristics of the patient groups and controls. The mean (\pm SEM) value of age of patients with IHF (58.05 ± 1.38 year) is comparable to the age of patients with CAD without HF (57.25 ± 1.99 year). Similarly, the weight of patients with IHF and those with CAD without HF did not differ significantly (76.70 ± 1.32 kg, 76.0 ± 1.36 kg, respectively). Moreover, the other clinical characteristics including; duration of disease, and cigarette smoking did not differ significantly between the groups of patients. Table 2 reveals the mean (\pm SEM) values of fasting plasma glucose, total cholesterol and LDL-cholesterol in patient groups and controls. The mean (\pm SEM) value of plasma glucose concentrations in patients with IHF (127 ± 7.64 mg/dl) was significantly higher than that obtained from healthy subjects (80.8 ± 2.52 mg/dl, $P < 0.0001$). In CAD without HF group, the mean (\pm SEM) value of plasma glucose levels did not differ significantly from that of control group (93.6 ± 3.96 mg/dl, 80.8 ± 2.52 mg/dl, respectively). Furthermore, the mean (\pm SEM) value of plasma glucose levels in IHF patients was significantly elevated when compared to that of patients with CAD without HF ($P < 0.0001$) (Table 2). The mean values of serum total cholesterol and LDL-Cholesterol in IHF patients (4.85 ± 0.33 mmol/L, 3.44 ± 0.30 mmol/L, respectively) are comparable to those obtained from CAD patients without HF (4.87 ± 0.30 mmol/L, 3.55 ± 0.29 mmol/L, respectively) (Table 2).

Table 1 : Clinical data of patients with ischemic heart failure (ihf), coronary artery disease (cad) without heart failure and controls.

	Ischemic Heart Failure (IHF)	Coronary Artery Disease without Heart Failure	Controls
Number (No.)	28	22	22
females (males)	6(22)	3(19)	8(14)
Age (year)	58.05 ± 1.38	57.25 ± 1.99	44.49 ± 1.84
Weight (kg)	76.7 ± 1.32	76.0 ± 1.36	73.84 ± 1.09

Results expressed as mean (\pm SEM).

Table 2: Mean (\pm SEM) serum values of fasting glucose, Total cholesterol, and low density lipoprotein-(LDL)cholesterol in IHF, CAD without HF and control groups.

	IHF n=28	CAD without HF n=22	Control n=22
Glucose (mg/dl)	127 \pm 7.64 ^o	93.60 \pm 3.96	80.8 \pm 2.52
Total cholesterol (mmol/L)	4.85 \pm 0.33 ^{oo}	4.87 \pm 0.30	4.39 \pm 0.28
LDL-Cholesterol (mmol/L)	3.44 \pm 0.30 ^{oo}	3.55 \pm 0.29	3.16 \pm 0.29

^o ANOVA tests between the IHF group on one hand and CAD without HF and control groups on the other hand; P<0.0001.

^{oo} ANOVA tests: No significant differences among the three groups.

DISCUSSION:

The result of the present study showed that all the studied traditional coronary heart disease (CHD) factors including; age, weight, cigarette smoking, (Table 1), total cholesterol and LDL-cholesterol levels (Table 2) did not differ significantly in patients with IHF when compared to those of patients with CAD without HF.

The important result of present study is that the mean (\pm SEM) value of plasma glucose concentrations in patients with IHF was significantly increased in comparison with that of patients with CAD without HF (Table 2). It has observed that diabetes mellitus increases the likelihood of HF in patients without structural heart disease and adversely affects the outcome of patients with established HF ⁽¹⁾. Tenenbaum et al, 2005 ⁽¹⁴⁾ concluded that diabetes mellitus was associated with increased prevalence of HF among patients with CAD. Similarly, Hoogwerf and associates, 2002 ⁽¹⁰⁾ suggested that blood glucose is independently associated with the prevalence of CHD. Stranders et al, 2004 ⁽¹⁵⁾ showed that admission blood glucose level after acute myocardial infarction may serve to identify subjects with long-term mortality risk, in particular among those with unknown diabetes. Recently, study of Barsheshet et al, 2006 ⁽¹⁶⁾ revealed that admission blood glucose level is associated with increased in-hospital and 60-day mortality in non-diabetic patients hospitalized because of heart failure (HF).

Hyperglycemia may contribute to exacerbation of HF by several independent mechanisms; ⁽¹⁾ hyperglycemia inhibits production of nitric oxide and increases the production of reactive oxygen species in endothelial and vascular smooth muscle cells, thus impairing endothelial function, ⁽²⁾ hyperglycemia may be a marker of insulin deficiency, which is associated with increased lipolysis resulting in excess circulating free fatty acids, which are toxic to ischemic myocardium and cause damage to myocyte

membranes, and ⁽³⁾ hyperglycemia enhances platelet-dependent thrombosis which can accelerate atherosclerosis ⁽¹⁶⁾.

CONCLUSION:

The present study revealed that plasma glucose status may play an important role, even partially, in the pathogenesis of IHF in patients with CAD and normal LV function. Evaluation of plasma glucose level in each patient with CAD is necessary in order to reduce (partially) the development and progression of CAD to IHF.

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